DESCRIPTION

POLYESTER COMPOSITE THICK-AND-THIN YARN, PROCESS FOR PRODUCING SAME, AND WOVEN OR KNITTED FABRIC THEREOF

TECHNICAL FIELD

This invention relates to a polyester composite thick-and-thin yarn, a process for producing the same and a woven or knitted fabric produced from the same. More particularly, the present invention relates to a polyester composite thick-and-thin yarn having a spun yarn-like appearance and a natural fiber grandrelle yarn-like dyeability, a process for producing the yarn with high efficiency and a woven or knitted fabric produced from the yarn and having a spun yarn woven or knitted fabric-like appearance and a natural fiber grandrelle yarn-woven or knitted fabric-like dyeability.

BACKGROUND ART

It is known that a multi-colored composite textured yarn having a grandrelle yarn- or sprinkly colored yarn-like appearance is produced by combining two or more types of filament yarns different in dyeability from each other to provide a composite yarn structure having dark colored portions and light colored portions, which portions may be the same in color hue as each other but different in color density from each other, or different in color hue from each other, and are distributed randomly in the yarn.

For example, Japanese Examined Patent Publication No. 62-57728 discloses a composite multifilament yarn in which high dyeability portions formed from thick portions of a thick-and-thin multifilament yarn, which thick portions are in a pseudo-melted or melted state, wound around a high orientation degree multifilament yarn and low dyeability portions formed from portions of the high orientation degree multifilament yarn, which portions

loosely surround thin portions of the thick-and-thin multifilament yarn and are opened and crimped, are alternately arranged with each other. The difference in dyeability between the thick-and-thin multifilament yarn and the high orientation degree multifilament is that, in the low dyeability portions of the composite yarn, the high orientation degree multifilament yarn has a higher dyeability than that of the thin portions of the thick-and-thin multifilament yarn.

Japanese Unexamined Patent Publication No. 2001-073238 discloses a false-twist textured composite yarn comprising a thick-and-thin multifilament yarn and a filament yarn having a higher dyeability than that of the thick-and-thin multifilament yarn and a uniform thickness. This composite yarn has ① low dyeability portions in which the thick-and-thin multifilament yarn in a crimped condition are wound around the high dyeability multifilament yarn and ② high dyeability portions in which the thick-and-thin multifilament yarn and the high dyeability multifilament yarn are mixed and interlaced with each other.

The conventional multifilament composite yarn exhibits a natural fiber grandrelle yarn-like appearance. However, as the thick-and-thin multifilament yarn wound around the multifilament yarn having the high dyeability and the uniform thickness has been passed through a crimping procedure in which the polymer molecules are fully orientated, the resultant composite yarn exhibits a low softness and thus is unsatisfactory in spun yarn-like touch and appearance.

DISCLOSURE OF THE INVENTION

An object of the present invention is to provide a polyester composite thick-and-thin multifilament yarn having a spun yarn-like appearance and touch and dyeable in a natural yarn grandrelle yarn-like color, a process for producing the same and a woven or knitted fabric

having a spun yarn woven or knitted fabric-like appearance and touch and dyeable in a natural fiber grandrelle yarn woven or knitted fabric-like color.

The above-mentioned object can be attained by the polyester composite thick-and-thin multifilament yarn, the process for producing the same and the woven or knitted fabric produced from the same.

The polyester composite thick-and-thin multifilament yarn of the present invention comprises:

(A) a polyester thick-and-thin multifilament yarn comprising a plurality of polyester individual thick-and-thin filaments each having a plurality of thick portions and a plurality of thin portions alternately arranged with each other along the longitudinal axis of each individual filament; and

(B) a polyester multifilament yarn having a higher dyeability than that of the thick-and-thin multifilament-yarn (A) and comprising a plurality of polyester individual filaments each having a thickness which is substantially uniform along the longitudinal axis of the each individual filament; combined and interlaced with the polyester thick-and-thin multifilament yarn (A), to form a composite thick-and-thin yarn, wherein

(a) in each of the composite thick portions of the composite thick-and-thin yarn, portions of the plurality of individual filaments in the multifilament yarn (B) are distributed substantially in a center part of the composite thick portion of the composite yarn, to form a core part, and the thick portions of the plurality of the individual thick-and-thin filaments in the thick-and-thin multifilament yarn (A) are distributed around the core part, to form a sheath part, and to thereby constitute a core-in-sheath structure in the composite thick portion; and

(b) in each of the composite thin portions of the composite thick-and-thin yarn, thin portions of the plurality of individual thick-and-thin filaments in the

thick-and-thin multifilament yarn (A) and portions of the plurality of individual filaments in the multifilament yarn (B) are distributed, as a random mixture, with each other.

In the polyester composite thick-and-thin yarn of the present invention, a ratio of a total length of the composite thick portions (a) contained in the composite thick-and-thin yarn to the length of the composite thick-and-thin yarn is preferably in the range of from 40 to 90%.

In the polyester composite thick-and-thin yarn of the present invention, a yarn length difference percentage between the polyester multifilament thick-and-thin yarn (A) and the polyester multifilament yarn (B), as defined by the equation (1):

$$\text{Yarn length difference percentage (\%)} = (Ls - Lc)/LC \times 100 \quad (1)$$

in which equation (1), Ls represents an average length of the individual filaments contained in the polyester thick-and-thin multifilament yarn (A) and Lc represent an average length of the individual filaments contained in the polyester multifilament yarn (B), the average filament lengths Ls and Lc being determined in accordance with JIS L 1015-1998, 7.4.1 (3) method,

is preferably in the range of from 5 to 15%.

In the polyester composite thick-and-thin yarn of the present invention, the polyester multifilament yarn (B) is preferably dyeable by cationic dyes.

The process for producing the polyester composite thick-and-thin yarn of the present invention as defined above comprises the steps of:

laying parallel a polyester thick-and-thin multifilament yarn (Aa) which comprises a plurality of polyester individual filaments each having thick portions and thin portions alternately arranged with each other along the longitudinal axis of the each individual filament, and has an ultimate elongation of 80 to 150%

and a shrinkage in boiling water of 30 to 60%, and a polyester multifilament yarn (Ba) which comprises a plurality of polyester individual filaments having a thickness substantially uniform along the longitudinal direction of the polyester individual filaments, exhibits a higher dyeability than that of the polyester thick-and-thin multifilament yarn (Aa) and has an ultimate elongation of 20 to 70% and a shrinkage in boiling water of 10 to 20%, to each other;

subjecting the paralleled composite yarn to a mixing and interlacing procedure under an air jetting pressure of 30 to 600 kPa at a processing speed of 200 to 800 m/min.; and

heat-treating the mixed and interlaced composite yarn at an overfeed rate of 0.5 to 3.0% at a heating temperature of 150 to 230°C.

The woven or knitted fabric of the present invention comprises the polyester composite thick-and-thin yarns as defined above.

In the woven or knitted fabric of the present invention, a width ratio W_1/W_2 of an apparent largest width W_1 to an apparent smallest width W_2 of the polyester composite thick-and-thin yarns contained in the woven or knitted fabric is preferably in the range of from 1.1 to 1.7.

The woven or knitted fabric of the present invention may be one further processed by a mass-reduction treatment with an alkali, which alkali-treated woven or knitted fabric has a plurality of cracks formed on the peripheral surfaces of the thick portions of the plurality of polyester individual thick-and-thin filaments contained in the polyester composite thick-and-thin yarn.

The woven or knitted fabric of the present invention may be one, further processed by a mass-reduction treatment with an alkali, in which an alkali-treated woven or knitted fabric, a width ratio W'_1/W'_2 of an

apparent largest width W'_1 to an apparent smallest width W'_2 of the polyester composite thick-and-thin yarns contained in the fabric, is in the range of from 1.1 to 1.7, and a plurality of cracks each extending in a direction intersecting the longitudinal axis of the individual thick-and-thin filaments are formed, on peripheral surfaces of the thick portions of the plurality of polyester individual thick-and-thin filaments in the polyester composite thick-and-thin yarn.

BRIEF DESCRIPTION OF THE DRAWING

Fig. 1(A) is an explanatory plane view of an embodiment of the polyester thick-and-thin multifilament yarn usable for the production of the polyester composite thick-and-thin yarn of the present invention,

Fig. 1(B) is an explanatory plane view of an embodiment of the polyester multifilament yarn having a high dyeability and a uniform thickness and usable for the production of the polyester composite thick-and-thin yarn of the present invention,

Fig. 2 is an explanatory plane view of an embodiment of the polyester composite thick-and-thin yarn of the present invention,

Fig. 3(A) is an explanatory cross-sectional view of a thick portion of an embodiment of the polyester composite thick-and-thin yarn of the present invention, and

Fig. 3(B) is an explanatory cross-sectional view of a thin portion of an embodiment of the polyester composite thick-and-thin yarn of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

The inventors of the present invention made extensive research on composite multifilament yarn by which the above-mentioned object can be attained. As a result, it has been found that, in a composite thick-and-thin multifilament yarn prepared by mixing and interlacing a polyester thick-and-thin multifilament yarn having a high elongation at breakage and a polyester

multifilament yarn having a lower elongation at breakage, a higher dyeability than those of the thick-and-thin yarn and a uniform thickness, and thereafter applying a heat treatment under relaxing to the resultant composite yarn, the thin portions of the polyester thick-and-thin multifilament yarn are significantly shrunk and the thick portions of the polyester thick-and-thin multifilament yarn exhibit a low shrinkage. Also, it has been found that by skillfully utilizing the above-mentioned effects on the composite yarn, the target composite thick-and-thin yarn and woven or knitted fabric comprising the yarn can be obtained. The present invention was completed on the basis of the above-mentioned findings.

The polyester composite thick-and-thin multifilament yarn of the present invention comprises:

(A) a polyester thick-and-thin multifilament yarn (which will be referred to as a thick-and-thin multifilament yarn hereinafter) comprising a plurality of polyester individual thick-and-thin filaments each having a plurality of thick portions and a plurality of thin portions alternately arranged with each other along the longitudinal axis of each individual filament; and

(B) a polyester multifilament yarn having a higher dyeability than that of the thick-and-thin multifilament yarn (A) and comprising a plurality of polyester individual filaments each having a thickness which is substantially uniform along the longitudinal axis of the each individual filament; combined and interlaced with the polyester thick-and-thin multifilament yarn (A), to form a composite thick-and-thin yarn. The polyester multifilament yarn (A) may be referred to as a high dyeability multifilament yarn, hereinafter.

The polyester polymers usable for forming the thick-and-thin multifilament yarn (A) for the composite thick-and-thin yarn of the present invention can be selected from polyalkylene aromatic dicarboxylate esters produced from an alkylene diol component and an aromatic

discarboxylic acid (or an ester thereof) component, for example, polyethylene terephthalate, polytrimethylene terephthalate and polybutylene terephthalate; and polyester copolymers produced by copolymerizing the above-mentioned diol component monomer and aromatic dicarboxylic acid component monomer and an additional comonomer, for example, isophthalic acid or adipic acid, for example, isophthalic acid-comonomerized polyethylene terephthalates. Particularly, the polyethylene terephthalate polymer is preferably employed as a polyester polymer for the thick-and-thin composite yarn (A).

There is no limitation to the type of the polyester polymer for forming the high dyeability multifilament yarn (B) for the present invention, as long as the polyester polymer for the multifilament yarn (B) has a higher dyeability than that of the polyester polymer for the thick-and-thin multifilament yarn (A). Preferably, the polyester polymer for the high dyeability multifilament yarn (B) is selected from (1) anion-modified polyester polymers in which a dicarboxylic acid component containing, for example, terephthalic acid, further contains 1.0 to 5.0 molar% of a comonomeric anionic monomer, for example, sodium sulfoisophthalic acid and thus which are dyeable with catioinic dyes, and (2) polyester copolymers in which a terephthalic acid component and a ethylene glycol component are copolymerized with a diol monomer different from ethylene glycol (for example, polyethylene glycol), a dicaboxylic acid monomer different from terephthalic acid (for example, isophthalic acid or adipic acid) or a hydroxymonocarboxylic acid monomer, and which exhibit enhanced dyeability with disperse dyes. More particularly, the polyester polymers are selected from the modified polyester copolymers containing the anionic comonomers and exhibiting a dyeability with cationic dyes.

The high dyeability polyester polymers as mentioned above may contain a coloring pigment mixed into the polymers by kneading.

The composite thick-and-thin yarn of the present invention has a structure described below.

(a) In each of the composite thick portions of the composite thick-and-thin yarn, portions of the plurality of individual filaments in the multifilament yarn (B) are distributed in a substantial center part of the composite thick portion of the composite yarn, to form a core part, and the thick portions of the plurality of the individual thick-and-thin filaments in the thick-and-thin multifilament yarn (A) are distributed around the core part, to form a sheath part, and to thereby constitute a core-in-sheath structure in the composite thick portion.

(b) In each of the composite thin portions of the composite thick-and-thin yarn, thin portions of the plurality of individual thick-and-thin filaments in the thick-and-thin multifilament yarn (A) and portions of the plurality of individual filaments in the multifilament yarn (B) are distributed in a random mixture with each other.

In the composite thick portions (a) of the composite thick-and-thin yarn, the individual high dyeability filaments are located in the core part and the individual thick-and-thin filaments having a lower dyeability than that of the individual high dyeability filaments surround around the composite thick-and-thin yarn in the core part to form a sheath part namely a surface layer of the composite yarn. Thus, when the composite thick-and-thin yarn is dyed, the apparent color density of the composite thick portions (a) is governed by the thick-and-thin filaments (A) having a relatively low color density. Compared with this, in the thin portions (b) of the composite thick-and-thin yarn, the individual thick-and-thin filaments having a low dyeability and the high dyeability filaments are randomly mixed with each other

and, therefore, the apparent color density of the composite thin portions (b) of the dyed composite thick-and-thin yarn is apparently higher than that of the composite thick portions (a).

For example, in the case where the thick-and-thin multifilament yarn (A) is constituted from a plurality of individual thick-and-thin filaments comprising, as a principal component, a polyethylene terephthalate polymer and the high dyeability multifilament yarn (B) is constituted from a plurality of cationic dye-dyeable individual filaments comprising, as a comonomer, a copolymerized aninoic group-containing monomer, and the resultant composite yarn is dyed with a cationic dye, since the individual thick-and-thin filaments are non-dyeable with the cationic dye, in the composite thick portion of the dyed composite yarn, only the individual filaments from which the core part is formed, are colored, the individual thick-and-thin filaments, from which the sheath part (the surface layer) is formed, are not colored. Therefore, the composite thick portions of the composite yarn appear, as a whole, to be light colored particularly sprinkly light colored, namely the colored individual filaments in the core part are sprinkled through the non-colored individual filaments in the sheath part. Compared with this, in the composite thin portions of the composite yarn, the non-colored individual filaments and colored individual filaments are randomly mixed with each other and, thus, the composite thick portions are sprinkly colored in a higher color density than that of the composite thick portions. Even in the case where the dyeability of the individual thick-and-thin filaments for the thick-and-thin multifilament yarn (A) with disperse dye or cationic dyes is lower than that of the individual filaments of the high dyeability multifilament yarn (B), the similar multicolor-mixing effect to the above-mentioned composite yarn can be attained. In the thick-and-thin multifilament yarn (A)

usable for the composite thick-and-thin yarn of the present invention, the thickness ratio α_A/α_B of an average cross-sectional area α_A of the thin portions to an average cross-sectional area α_B of the thick portions can be appropriately established. Usually, the thickness ratio α_A/α_B is preferably controlled in the range of from 0.35 to 0.95, more preferably from 0.5 to 0.8.

The cross-sectional area ratio α_A/α_B can be determined by cutting 20 thick portions and 20 thin portions randomly sampled from a sample of a thick-and-thin multifilament yarn (A) at right angles to the longitudinal axis of the yarn, measuring the cross-sectional areas of cross-sectional profiles of the thick and thin portions by using an electron microscope, calculating the averages α_A and α_B of the cross-sectional areas of the thick and thin portions, and calculating the ratio of α_A to α_B.

When the area ratio α_A/α_B is less than 0.35, the resultant thick-and-thin multifilament yarn (A) may exhibit an insufficient mechanical strength. Also, when the area ratio is more than 0.95, and the resultant composite yarn is dyed, the resultant dyed composite yarn may exhibit an unsatisfactory grandrelle yarn-like coloring effect (or a sprinkly coloring effect).

In the thick-and-thin multifilament yarn usable for the composite thick-and-thin yarn, preferably, the thick portions of the multifilament yarn have a length in the range of from 5 to 170 mm, more preferably from 8 to 130 mm, and the thin portions have a length in the range of from 5 to 170 mm, more preferably from 8 to 130 mm. The lengths of the thick and thin portions are not limited to the above-mentioned range and, optionally, can be appropriately designed.

In the composite thick-and-thin yarn of the present invention, there are no limitations to the form of the

cross-sectional profiles of the individual thick-and-thin filaments of the thick-and-thin multifilament yarn (A) and of the individual filaments of the high dyeability multifilament yarn (B) and may be appropriately established. For example, the cross-sectional profiles may in a regular (circular) form or in an irregular form, for example, a triangular, a quadrangular, a rhombic or a flat rhombic form. The cross-sectional profile may be a hollow form or a non-hollow form.

There are no limitations to the thickness and yarn counts of the thick-and-thin multifilament yarn (A), the individual thick-and-thin filaments for the yarn (A), the high dyeability multifilament yarn (B), and the individual filaments for the yarn (B) of the composite thick-and-thin yarn of the present invention. The thicknesses and yarn counts may be appropriately established. Usually, the composite thick-and-thin yarn of the present invention preferably has a yarn count of 30 to 300 dtex/12 to 25 filaments, more preferably 50 to 200 dtex/24 to 72 filaments.

Also, preferably, the yarn counts of the thick-and-thin multifilament yarn (A) and the high-dyeability multifilament yarn (B) are respectively and independently from each other 30 to 300 dtex/10 to 50 filaments, more preferably 50 to 200 dtex/24 to 72 filaments, and the thickness of the individual thick-and-thin filaments for the thick-and-thin multifilament yarn (A) and the individual filaments for the high dyeability multifilament yarn are 0.6 to 10 dtex, more preferably 1 to 5 dtex.

The thick portions of the individual filaments contained in the thick-and-thin multifilament yarn (A) and located in the thick portions of the composite thick-and-thin yarn of the present invention have a lower degree of orientation of the polymer molecules, and a softer touch, than those of the thin portions of the individual filaments, form a sheath part (a peripheral

part) of the thick portions of the composite yarn, randomly expand outward from the composite yarn, and thus exhibit a natural fiber spun yarn-like appearance and touch. Also, the individual thick-and-thin filaments of the thick-and-thin multifilament yarn (A) are, even in the thick portion thereof, interlaced with portions of the individual filaments of the high dyeability multifilament yarn (B) which is in combination with the thick-and-thin multifilament yarn (A) forming the sheath part of the composite yarn, and thus the sheath part and the core part are firmly combined with each other to form one body.

In the composite thick-and-thin yarn of the present invention, the composite thick portions and the composite thin portions are alternately formed along the longitudinal direction of the composite yarn. The total length of this composite thick portions preferably corresponds to 40 to 90%, more preferably 45 to 65%, based on the total length of the composite thick-and-thin yarn. When the proportion of the total length of the composite thick portions is less than 40% or more than 10% of the total length of the composite yarn, and the composite thick-and-thin yarn is dyed, the resultant dyed yarn may exhibit an unsatisfactory grandrelle yarn-like color in comparison with a dyed natural fiber grandrelle yarn, and the appearance and touch of the dyed yarn may be unsatisfactory in comparison with those of the natural fiber spun yarn.

In the composite thick-and-thin yarn of the present invention, the true length of the thick-and-thin multifilament yarn (A) are longer than the true length of the high dyeability multifilament yarn (B) contained in the composite yarn. Namely, in the composite thick-and-thin yarn of the present invention, a yarn length difference percentage (%) between a polyester composite thick-and-thin multifilament yarn (A) and a polyester multifilament yarn (B) contained in a composite thick-

and-thin yarn having a length of 5 cm, and defined by the equation (1):

$$\text{Yarn length difference percentage (\%)} = (Ls - Lc)/LC \times 100 \quad (1)$$

in which equation (1), Ls represents an average length of the individual filaments contained in the polyester thick-and-thin multifilament yarn (A) and Lc represent an average length of the individual filaments contained in the polyester multifilament yarn (B), the average filament lengths Ls and Lc being determined in accordance with JIS L 1015-1998, 7.4.1 (3) method,

is preferably in the range of 5 to 15%, more preferably 8 to 14%. The averages, as mentioned above, are calculated from data of the samples in a number (n) of 20.

If the yarn length difference percentage is less than 5%, the resultant composite thick-and-thin yarn may exhibit unsatisfactory natural fiber spun yarn-like appearance and touch. Also, if it is more than 15%, the resultant composite thick-and-thin yarn may be disadvantageous in that when the composite yarn is subjected to an unwinding procedure or twisting procedure, slippage and damage of the yarn (which refers to a deviation of the yarn from a regular position in the yarn package and to damage given on the peripheral portion of the yarn) may occur.

The composite thick-and-thin yarn of the present invention can be produced by the process of the present invention for producing the composite yarn.

The composite thick-and-thin yarn of the present invention can be produced from a polyester thick-and-thin multifilament yarn (Aa) which comprises a plurality of polyester individual filaments each having thick portions and thin portions alternately arranged with each other along the longitudinal axis of the each individual filament, and has an ultimate elongation of 80 to 150% and a shrinkage in boiling water of 30 to 60%, and a

polyester multifilament yarn (Ba) which comprises a plurality of polyester individual filaments having a thickness substantially uniform along the longitudinal direction of the polyester individual filaments, exhibits a higher dyeability than that of the polyester thick-and-thin multifilament yarn (Aa) and has an ultimate elongation of 20 to 70% and a shrinkage in boiling water of 10 to 20%.

The thick-and-thin multifilament yarn (Aa) and the high dyeability multifilament yarn (Ba) are laid parallel to each other, and the resultant paralleled composite yarn is subjected to a mixing and interlacing procedure in which an air blast is jetted toward the composite yarn under an air jetting pressure of 30 to 600 kPa to mix and interlace the individual filaments, from which the multifilament yarns (Aa) and (Ba) are constituted, with each other at a processing speed of 200 to 800 m/min. The resultant mixed and interlaced composite yarn is subjected to a relaxation-heat treatment wherein the composite yarn is fed at an overfeed percentage of 0.5 to 3.0% and the relaxed composite yarn is heat-treated at a temperature of 150 to 230°C. In the relaxation-heat treatment, the thick-and-thin multifilament yarn (Aa) and the high dyeability multifilament yarn (Ba) respectively shrink, are heat-set and are converted to a thick-and-thin multifilament yarn (A) and a high dyeability multifilament yarn (B). The shrinkage of the high dyeability multifilament yarn (Ba) due to the relaxation-heat treatment is higher than that of the thick-and-thin multifilament yarn (Aa) and, therefore, the multifilament yarn (Ba) substantially straightly shrinks. Compared with this, the shrinkage of the thick portions of the thick-and-thin multifilament yarn (Aa) is lower than that of the thin portions of the yarn (Aa), and thus the difference in shrinkage between the individual thick-and-thin filaments and the individual high dyeability filaments both located in the thick portions of the

resultant composite thick-and-thin yarn is larger than that in the thin portions of the resultant composite thick-and-thin yarn. Accordingly, in the thick portions having the larger shrinkage difference, the individual thick-and-thin multifilaments are expanded and bent around the core part formed from the individual high dyeability filaments, to form the sheath part. Also, in the thin portions having the smaller shrinkage difference, the shrinkage of the individual thick-and-thin filaments in the thick-and-thin multifilament yarn (A) is slightly lower than that of the individual filaments in the high dyeability multifilament yarn (B), and the difference in shrinkage between the individual thick-and-thin filaments and the individual high dyeability filaments is small and, therefore, both the individual thick-and-thin filaments and the individual high dyeability filaments are randomly mixed and interlaced with each other.

Figs. 1(A) and (B) respectively show a polyester thick-and-thin multifilament yarn 1 and a polyester high dyeability multifilament yarn 2. In the polyester thick-and-thin multifilament yarn 1, thick portions 3 and thin portions 4 are alternately arranged with each other.

By combining the thick-and-thin multifilament yarn 1 and the high dyeability multifilament yarn 2 in parallel to each other and subjecting the paralleled composite yarn to a interlacing procedure and then to a relaxation-heat treatment, the high dyeability multifilament yarn 2 shrinks at a high shrinkage rate and is converted to a shrunk high dyeability multifilament yarn 2A as shown in Fig. 2, and the thick-and-thin multifilament yarn 1 shrinks at a low shrinkage rate and converted to a thick-and-thin multifilament yarn 1A as shown in Fig. 2.

The resultant composite thick-and-thin yarn 5 is provided with thick portions 6 and thin portions 7 alternately arranged with each other. In the thick portions 6, the difference in filament length between

thin portions 1a of the individual thick-and-thin filaments in the thick-and-thin multifilament yarn 1A and portions 2a of the individual filaments in the high dyeability multifilament yarn 2A is large and thus the portions 2a of the individual high dyeability filaments are distributed to form a core part of each thick portions 6 and the thick portions 1a of the individual thick-and-thin filaments are distributed around the core part and expanded in curved form to form a sheath part, as shown in Fig. 2 and 3(A). Also, in the thin portions 7, as shown in Figs. 2 and 3(B), the filament length of the thin portions 1b in the individual thick-and-thin filaments is substantially equal to that of the portions 2a of the individual high dyeability filaments (or the thin portions 1b in the individual thick-and-thin filaments is slightly longer than the portions 2a of the individual high dyeability filaments), and therefore the thin portions 1b of the individual thick-and-thin filaments and the portions 2a of the individual high dyeability filaments are mixed and distributed at random.

In the composite thick-and-thin yarn of the present invention, it is preferable that the individual filaments of the polyester thick-and-thin multifilament yarn (A) and the individual filaments of the polyester high dyeability multifilament yarns are not melt-bonded to each other and are in a non-crimped form.

The polyester thick-and-thin multifilament yarn (A) usable for the production process of the present invention has an ultimate elongation of 80 to 150%, preferably 100 to 130% and a shrinkage in boiling water of 30 to 60%, preferably 45 to 55%. Also, the polyester high dyeability multifilament yarn (B) usable for the process of the present invention has an ultimate elongation of 20 to 70%, preferably 30 to 50% and a shrinkage in boiling water of 10 to 20%, preferably 13 to 18%. The employment of the multifilament yarns (A) and (B) having the above-mentioned properties as material

yarns for the process of the present invention enables a target difference in yarn length between the thick-and-thin multifilament yarn (A) and the high dyeability multifilament yarn (B) in the resultant composite thick-and-thin yarn to be created.

In the production process of the present invention, a difference in ultimate elongation between the polyester thick-and-thin multifilament yarn and the polyester high dyeability multifilament yarn used as material yarns is preferably controlled to 50 to 120%, more preferably 70 to 100%.

The polyester thick-and-thin multifilament yarn usable for the process of the present invention may be selected from those, for example, produced by an uneven drawing procedure in which an undrawn polyester multifilament yarn produced from a conventional disperse dye-dyeable polyester polymer is directly, or after winding-up, unevenly drawn at a low draw ratio and then the unevenly drawn multifilament yarn is heat-treated. Also, the polyester multifilament yarn having a high dyeability may be selected from those, for example, produced from conventional cationic dye-dyeable polyester polymer by a conventional melt-spinning method. The cationic dye-dyeable polyester polymer usually exhibits a higher dyeability to disperse dyes than that of conventional disperse dye-dyeable polyester polymer and thus is preferred as a polymer for polyester multifilaments having a high dyeability. When prepared through a cold drawing procedure at a draw ratio of 1.1 to 1.4, the resultant polyester multifilament yarn exhibit a further enhanced dyeability and this drawing procedure enables the high dyeability multifilament yarn having the shrinkage in boiling water within the range as mentioned above to be easily obtained.

In the process for producing the composite thick-and-thin yarn of the present invention, the mixing and interlacing procedure is applied to both the

multifilament yarns (Aa) and (Ba) at a processing speed of 200 to 800 m/min. at a compressed air pressure of 30 to 600 kPa by an interlacing method. In this procedure, the multifilament yarns (Aa) and (Ba) may be further combined with another yarn, as long as the object of the present invention can be attained. Also, the interlace method may be replaced by any other mixing and entangling method, for example a TASLAN (trademark) method. The interlacing method may be used in combination with another mixing and entangling method.

As a method for mixing and entangling the yarns (A) and (B), an air jetting method, for example, the interlace method or the TASLAN method, is preferably utilized. Among them, the interlace method is particularly preferred. In this case, a conventional interlace nozzle can be used for the process of the present invention. The number of interlacements (entanglements) of individual filaments is preferably about 25 to 50 interlacements per m.

In the mixing and interlacing procedure, a composite false-twisting method is not preferred. In the composite false-twisting method, the polyester thick-and-thin multifilament yarn (A) having a high elongation comes to a sheath part of the resultant composite yarn. In this case, the polyester polymer molecules of the polyester thick-and-thin multifilament yarn (A) are fully orientated and, thus, the resultant composite yarn may not exhibit excellent natural fiber spun yarn-like appearance and touch and the object of the present invention may not be attained.

After the mixing and interlacing procedure, the resultant interlaced composite yarn is subjected to the relaxation and heat-treatment at an overfeed percentage of 0.5 to 3.0% at a heat treatment temperature of 150 to 230°C, preferably 200 to 220°C. The composite thick-and-thin yarn of the present invention can be easily provided by the above mentioned process.

In accordance with the present invention, a woven or knitted fabric comprising the above-mentioned composite thick-and-thin yarn is preferably in a content of 30% by mass or more.

The woven or knitted fabric of the present invention may be constituted from only the composite thick-and-thin yarn of the present invention or may be produced by incorporating the composite thick-and-thin yarn with other yarns of fibers, for example, polyester fibers, nylon fibers or natural fibers, the resultant composite yarn is subjected, after an optional processing procedure, for example, an air-jet interlacing treatment, and an additional optional processing procedure, for example, a twisting procedure, to a weaving or knitting procedure.

The weaving structure of the woven fabric preferably selected from plain weaves, twill means, satin weaves and modifications of the above-mentioned weave structures. The knitting structures of the knitted fabrics may be selected from tubular knitting structures, for example, interlock structures, weft knitting structures and warp knitting structure. The composite thick-and-thin yarn is provided with thick portions (a) in which the thick portions having a soft touch of the thick-and-thin multifilament yarn (A) are located in the sheath parts of the thick portions (a), and thin portions (b) located between the thick portions (a), and thus the woven or knitted fabric comprising the composite thick-and-thin yarn exhibits natural fiber spun yarn-like appearance and touch even before the dyeing procedure is applied thereto.

When a pre-setting treatment (heat treatment) is applied to the woven or knitted fabric of the present invention, the thick portions of the thick-and-thin multifilament yarn (A) located in the sheath parts of the thick portions (a) of the composite thick-and-thin yarn contained in the woven or knitted fabric self-elongate so

as to further enhance the natural fiber spun yarn-like appearance and touch.

In this case, a ratio W_1/W_2 of a apparent largest width W_1 to an apparent smallest width W_2 of the composite thick-and-thin yarns contained in the woven or knitted fabric is preferably in the range of from 1.1 to 1.7, more preferably from 1.2 to 1.5. The largest width W_1 and the smallest width W_2 are determined by a measurement in which a magnified photograph of a surface of the woven or knitted fabric is taken; and on the magnified photo, the widths of the thick portions (a) appearing in 20 regions in which only the thick portions (a) appear in the weaving or knitting structure and the widths of the thin portions (b) appearing in 20 regions in which only the thin portions (b) appear in the weaving or knitting structure are measured at a location between the regions in the weaving oar knitting structure, and the averages W_1 and W_2 are calculated from the measured data.

The natural fiber spun yarn-like appearance and touch of the woven or knitted fabric comprising the composite thick-and-thin yarn of the present invention, particularly having a ratio W_1/W_2 in the range of from 1.1 to 1.7 can be enhanced by applying a mass-reduction treatment with alkali to the fabric to cause a plurality of cracks to be selectively formed on the peripheral surfaces of the thick portions of the thick-and-thin filaments in the yarn (A). In this treatment, the reduction in mass of the fabric is preferably controlled in the range of from 15 to 25%.

When a dyeing treatment is applied to the mass-reduced woven or knitted fabric with alkali, the thick portions of the composite yarns are colored in a light color and the thin portions of the composite yarns are colored in a dark color, and thus the resultant dyed woven or knitted fabric exhibits a natural fiber grandrelle yarn woven or knitted fabric-like appearance

and a natural fiber spun yarn woven or knitted fabric-like appearance and touch. In this case, when the polyester high dyeability multifilament yarns are dyeable with cationic dyes, the composite thick-and-thin yarn woven or knitted fabric is preferably dyed with the cationic dyes.

The woven or knitted fabric may be further processed by a water absorption-enhancing, water-repellent, nap-raising or ultraviolet ray-shielding treatment or a function-imparting treatment with an antistatic agent, flame retardant agent, antibacterial agent, deodorant, insectfuge, light accumulator, return-reflecting agent and negative ion-generator.

EXAMPLES

The present invention will be further explained by the following examples which are not intended to limit the scope of the present invention in any way.

In the examples and comparative examples the following tests were carried out.

(1) Tensile strength and ultimate elongation of filaments

The tensile strength and ultimate elongation of filaments were measured in accordance with JIS L 1013.

(2) Shrinkage in boiling water of yarn

The shrinkage in boiling water of a yarn was measured in accordance with JIS L 1013.

(3) Grandrelle yarn-like appearance

The grandrelle yarn-like appearance of a dyed yarn was organoleptically evaluated, by three inspectors, into the following classes.

Class	Appearance
3	Dark colored portions and light colored portions are distributed just like a natural fiber grandrelle yarn.
2	The distribution of dark and light

	colored portions is closely allied to that in natural fiber grandrelle yarn.
1	Dark colored portions and light colored portions are distributed in high distribution density and the resultant appearance is significantly different from a natural fiber grandrelle yarn.

(4) Natural fiber spun yarn-like appearance and touch

The natural fiber spun yarn-like appearance and touch of the yarn were evaluated, by three inspectors, into the following three classes.

Class	Appearance and touch
3	The yarn has high bulkiness and softness and exhibits natural fiber spun yarn-like appearance and touch.
2	The appearance and touch of the yarn are closely allied to those of natural fiber spun yarn.
1	The bulkiness and softness of the yarn are unsatisfactory.

Example 1

A polyethylene terephthalate thick-and-thin multifilament yarn (A) having an ultimate elongation of 130%, a shrinkage in boiling water of 55%, a yarn count of 110 dtex/36 filaments a cross-sectional area ratio $\alpha A/\alpha B$ of thin portions to thick portions of 0.64, a length of thick portions of 10 to 80 mm and a length of thin portions of 10 to 60 mm, and a high dyeability polyester multifilament yarn (B) produced by cold-drawing an undrawn multifilament yarn of a polyethylene terephthalate copolymer containing, as a comonomer, 2.6 molar% of 5-sodium sulfoisophthalic acid at a draw

ratio of 1.2 and having an ultimate elongation of 35%, a shrinkage in boiling water of 15% and a yarn count of 84 dtex/24 filaments, were doubled; the doubled composite yarn was interlace-treated at a processing speed of 600 m/min. under an air jet pressure of 300 kPa, to provide a mixed and interlaced composite yarn having a number of interlacements of 30/m. The mixed and interlaced composite yarn was relaxed and heat treated at an overfeed rate of 1.3% at a taking up speed of 592 m/min, at a heating temperature of 180°C. A composite thick-and-thin yarn was obtained. The composite thick-and-thin yarn was observed through a magnifying glass. It was confirmed that, in the composite yarn, thick portions and thin portions are alternatively arranged with each other.

From the composite thick-and-thin yarn, a sample having a length of 1m was taken and the sample was adhered to a black-colored paper board. On the sample, the length of portions having the thick portion (a) structure and the length of portions having the thin portion (b) structure, and a percentage of the total length thick portions based on one meter sample was calculated. The percentage of the thick portions was 47%.

Twenty samples each having a length of 5 cm were taken from the composite thick-and-thin yarn. In each sample, the thick-and-thin multifilament yarn was separated from the high dyeability multifilament yarn, and the lengths of the yarns were measured. From the resultant data, the yarn length difference percentage of the composite yarn was calculated. The calculation result was 12%.

The composite thick-and-thin yarn was twisted at a twist number of 900 turns/m. The twisted composite thick-and-thin yarns were employed as warp and weft yarns to provide a woven fabric having a warp density of 140 yarns/2.54 cm, a weft density of 80 yarns/2.54 cm and

a 2/2 twill weave structure. The resultant woven fabric was subjected to a preliminary relaxation treatment at a temperature of 90°C, a liquid stream relaxation treatment at a temperature of 120°C, a pre-heat setting treatment at a temperature of 190°C and then a mass reduction treatment, with alkali, at a mass-reduction rate of 20%. Then the woven fabric was dyed with a black-coloring cationic dye at a temperature of 120°C, and was finally heat-set at a temperature of 170°C. The resultant woven fabric had a natural fiber grandrelle yarn woven fabric-like appearance evaluated in class 3 in which appearance the black colored portions and the grey-colored portions are dispersed in a white or light colored matrix as in natural fiber grandrelle yarn, and a natural fiber spun yarn woven fabric-like touch evaluated in class 3, including satisfactory bulky touch and soft touch. The woven fabric had a ratio W_1/W_2 of a largest width of to smallest width of the composite thick-and-thin yarn, of 1.4. Also, a plurality of cracks were formed on the peripheral surfaces of the thick portions of the polyester thick-and-thin filaments in the woven fabric.

Comparative Example 1

A composite thick-and-thin yarn was produced by the same procedures as in Example 1, except that the polyethylene terephthalate thick and thin multifilament yarn had an ultimate elongation of 40% and a shrinkage in boiling water of 10%.

In the observation of the resultant composite thick-and-thin yarn through a magnifying glass, no formation of thick portions (a) and thin portions (b) was found.

The composite thick-and-thin yarns were employed to produce a woven fabric and the resultant woven fabric was treated and dyed by the same procedures as in Example 1.

In the dyed fabric, the light colored portions and dark colored portions are distributed in a high distribution density, and the dyed fabric exhibited an unclear natural fiber grandrelle yarn woven fabric-like

appearance evaluated in class 1. The dyed fabric had unsatisfactory bulky touch and soft touch and exhibited a unsatisfactory natural fiber spun yarn woven fabric-like touch which was evaluated in class 1. In this woven fabric, the ratio W_1/W_2 of the largest width W_1 to the smallest width W_2 of the composite thick-and-thin yarns in the woven fabric, of 1.05. Also, a plurality of cracks were found in the thick portions of the thick-and-thin filaments.

INDUSTRIAL APPLICABILITY

The present invention provides a polyester composite thick-and-thin yarn capable of realizing not only a natural fiber grandrelle yarn-like appearance but also natural fiber spun yarn-like appearance and touch, a process for producing the composite yarn and a woven or knitted fabric having a natural fiber grandrelle yarn fabric-like appearance and natural fiber spun yarn fabric-like appearance and touch.